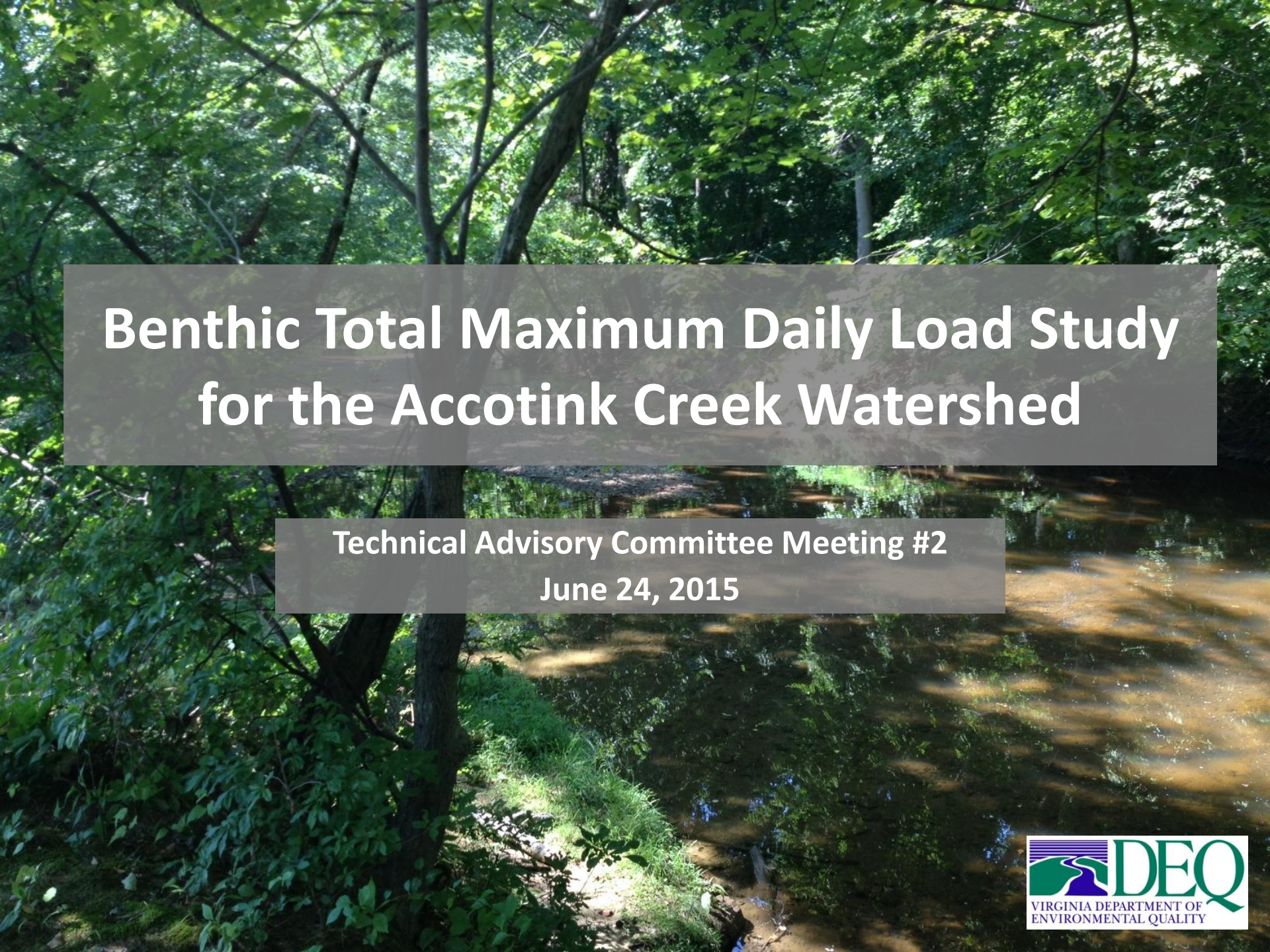


Benthic Total Maximum Daily Load Study for the Accotink Creek Watershed

Technical Advisory Committee Meeting #2
June 24, 2015

DEQ
VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY

Meeting Agenda

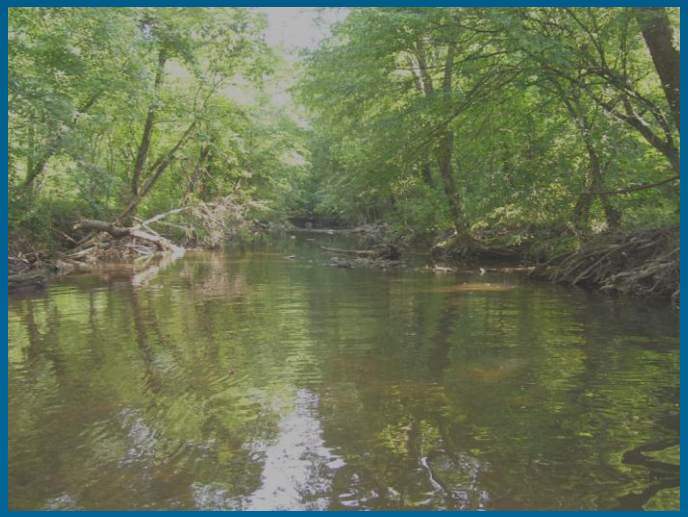
1. Introductions

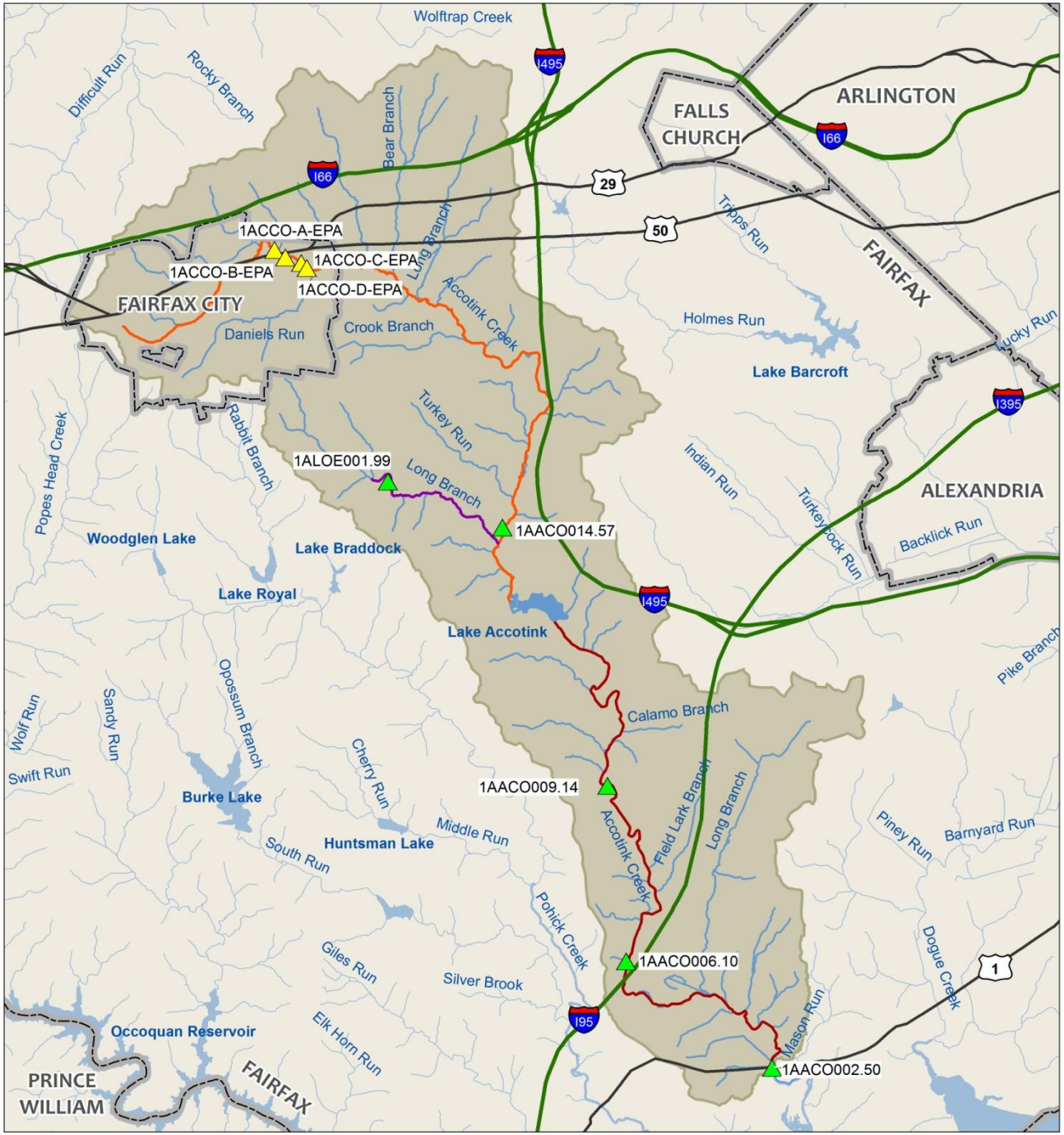
2. Background
   a. Benthic Impairments
   b. Overview of Stressor Analysis

3. Results of Draft Stressor Identification Analysis
   a. Water Quality Standards and Thresholds
   b. Non-Stressors
   c. Possible Stressor
   d. Most Probable Stressors

4. Next Steps & Timeline

5. Questions & Discussion





Legend

Biological Monitoring Stations

- DEQ
- EPA
- Streams

303d Listed Segments

- A15R-01-BEN
- A15R-04-BEN
- A15-R-05-BEN

Major Roads

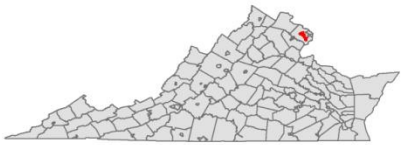
- Interstate
- US Hwy
- Jurisdictional Boundaries
- Waterbodies
- Accotink Watershed

Data Sources:
VADEQ – Watersheds, Impaired Segments, Monitoring Stations
USGS – National Hydrography Dataset
ESRI – Roads
US Census – Jurisdictinal Boundaries

N
W E
S

0 0.5 1 2 3 4
Miles

MAP INDEX



What is a Stressor Analysis?

Answers the question: ***What is causing the aquatic life impairment?***

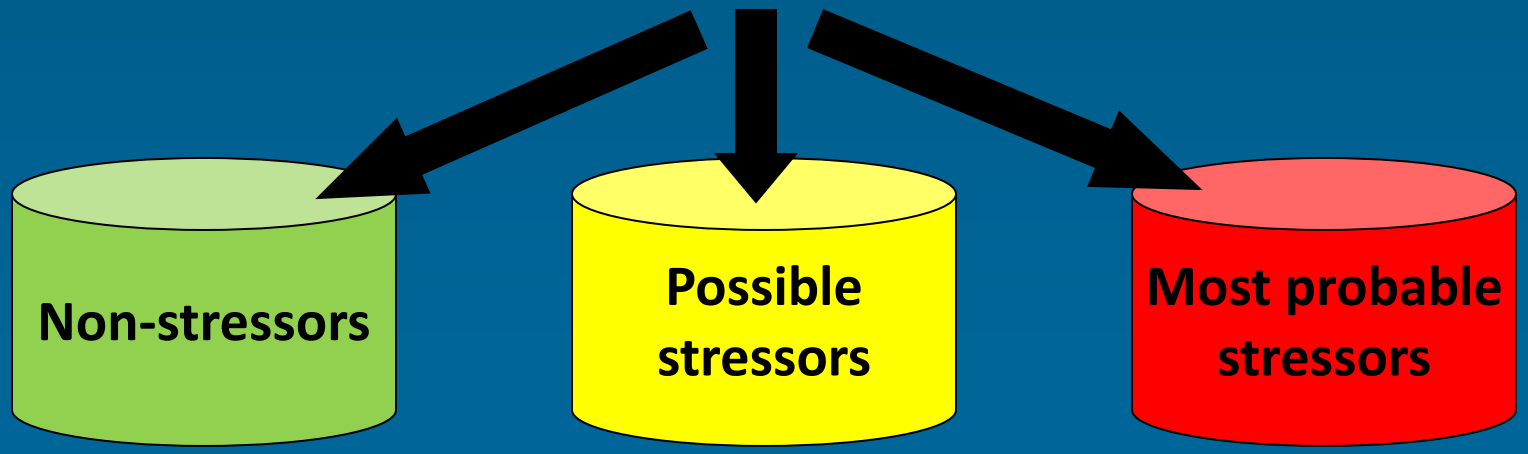
1. List all potential causes, for example:

   DO, nutrients, pH, sediment, temperature, toxics, etc.

2. Analyze the evidence for and against each cause:

   Biological, habitat, water quality, historic data, etc.

3. Categorize each of the causes as being one of the following:



Pollutant & Pollution
Clean Water Act, Section 502
General Definitions

- **Pollutant**

  "dredged spoil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt and industrial, municipal, and agricultural waste discharged into water"

- **Pollution**

  "the man-made or man-induced alteration of the physical, biological, chemical, and radiological integrity of water"

Stressor Identification Analysis

Classification of Stressors

Category	Stressor	
Non-Stressors	Temperature	pH
	Dissolved Oxygen	Metals
Possible Stressors	Nutrients	Toxics
Most Probable Stressors	Chloride	Habitat Modification
	Sediment	Hydromodification

Topics

- Water Quality Standards and Thresholds for Stressor Identification Analysis
- Non-Stressors
- Possible Stressors
- Most Probable Stressors

Virginia Water Quality Standards for Conventional Pollutants

Constituent	Criteria for Aquatic Life Use
Temperature	Maximum: 32°C; maximum hourly change in temperature: ± 2°C; No more than 3°C rise above natural conditions
pH	Minimum: 6.0; Maximum: 9.0
Dissolved Oxygen	Minimum: 4.0 mg/l; Daily Average 5.0 mg/l
Chloride	Acute[1]: 860 mg/l; Chronic[2]: 230 mg/l
Ammonia	Acute and chronic criteria function of pH and temperature

[1]One hour average concentration not to be exceeded more than once every three years, on average.
[2]Four-day average concentration not to be exceeded more than once every three years, on average.

Thresholds from ProbMon Program

ProbMon: Probabilistic Monitoring of benthics, water quality, habitat

- Sample sites chosen at random
- Sampled in spring and fall
- Generally not sampled during or after storm

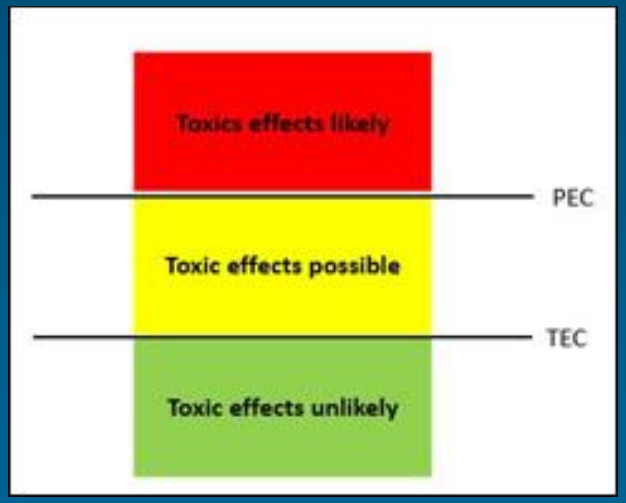
Two thresholds selected from ProbMon:

- 90th percentile concentration, ProbMon data 2001-2008
- Condition thresholds for assessing relative risk of biological impairment

Parameter	Optimal	Suboptimal	Relative Risk
Total Nitrogen	< 1 (mg/l)	> 2 (mg/l)	3.4
Total Phosphorus	< 0.02 (mg/l)	> 0.05 (mg/l)	3.9
Total Dissolved Solids	< 100 (mg/l)	> 350 (mg/l)	5.1
CCU Metals Index	< 1 (unitless)	> 2 (unitless)	4.3
Habitat	> 150 (of 200)	< 120 (of 200)	4.1
Relative Bed Stability Index	> - 0.5 (unitless)	< -1.0 (unitless)	2.8

Metals and Toxics Thresholds

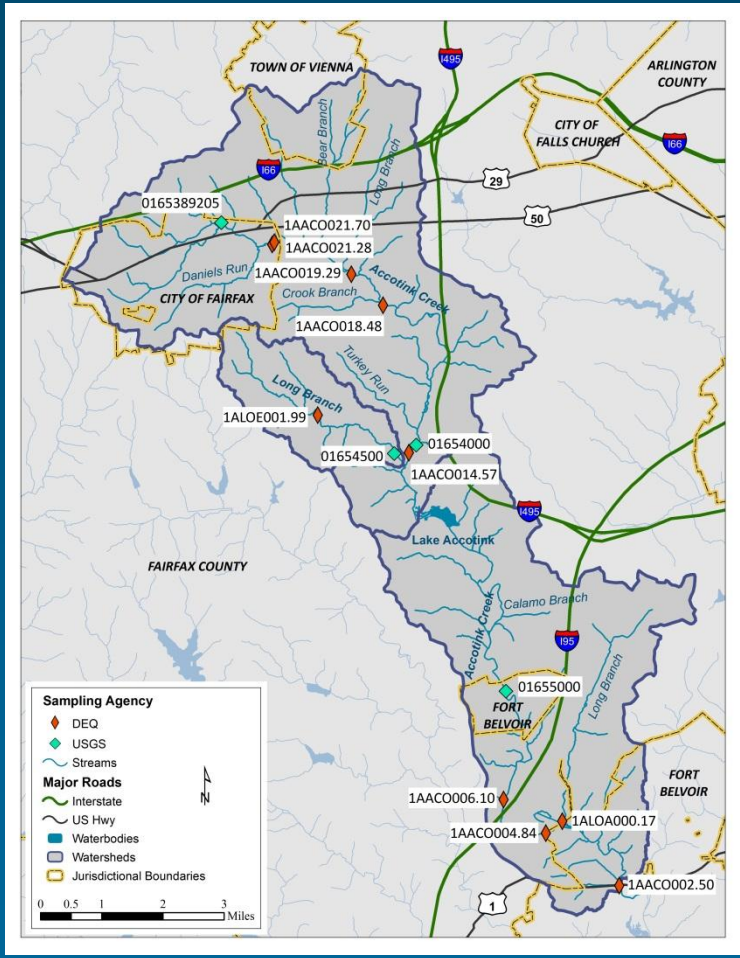
Media	Screening Thresholds
Water Column	Water Quality Standards
Sediment	NOAA Threshold Effects Concentrations (TECs) and Probable Effects Concentrations (PECs)
Fish Tissue	Tissue Values (TVs) or Tissue Screening Values (TSVs) (human health criteria)



Non-Stressors

- Temperature
- pH
- Dissolved Oxygen
- Metals

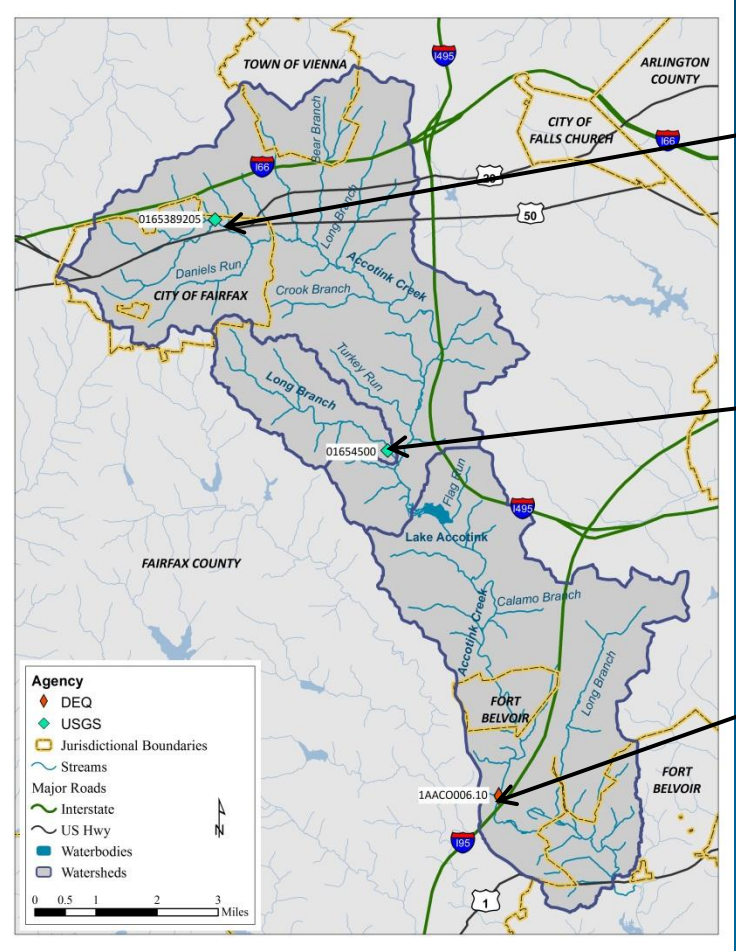
Conventional Water Quality Monitoring, 2004 -2014



Number of Discrete Samples :

Watershed	DEQ	USGS
Upper Accotink Creek	122	174
Lower Accotink Creek	111	0
Long Branch	2	74

Continuous Monitoring



Temperature, DO, pH, Specific Conductance, Turbidity: 11/19/2011-01/13/2015

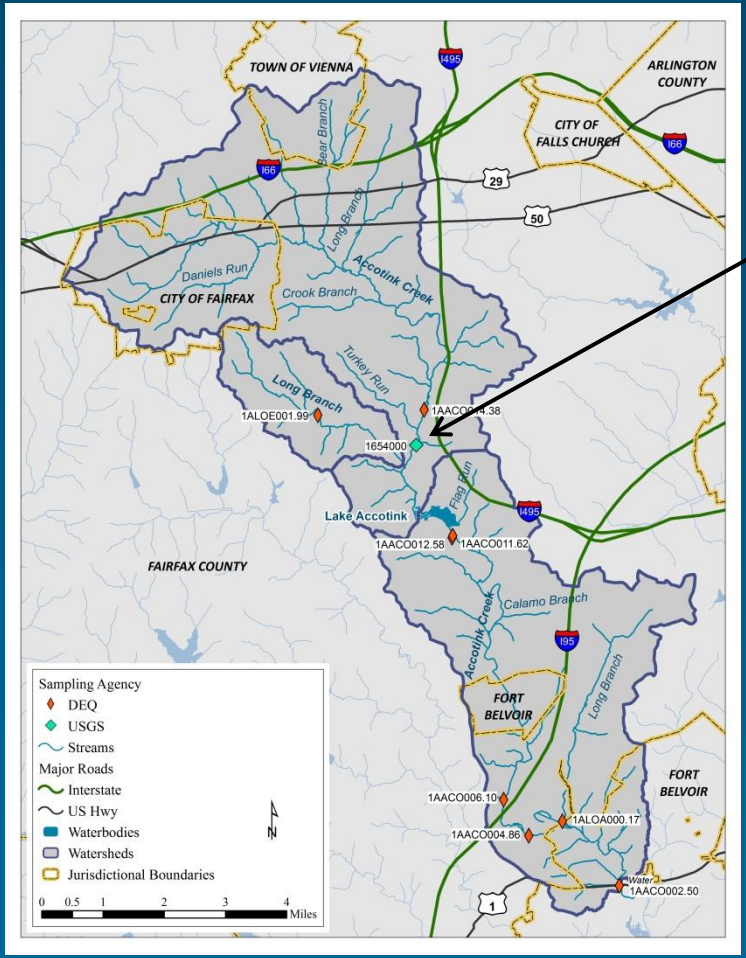
Temperature, DO, pH, Specific Conductance: 02/08/2013-present

Temperature, DO, pH, Specific Conductance: 08/03/2006-08/08/2006

Temperature, pH, and Dissolved Oxygen

Constituent	Water Quality Standards Met?
Temperature	✓
pH	✓
Dissolved Oxygen	✓

Metals Monitoring



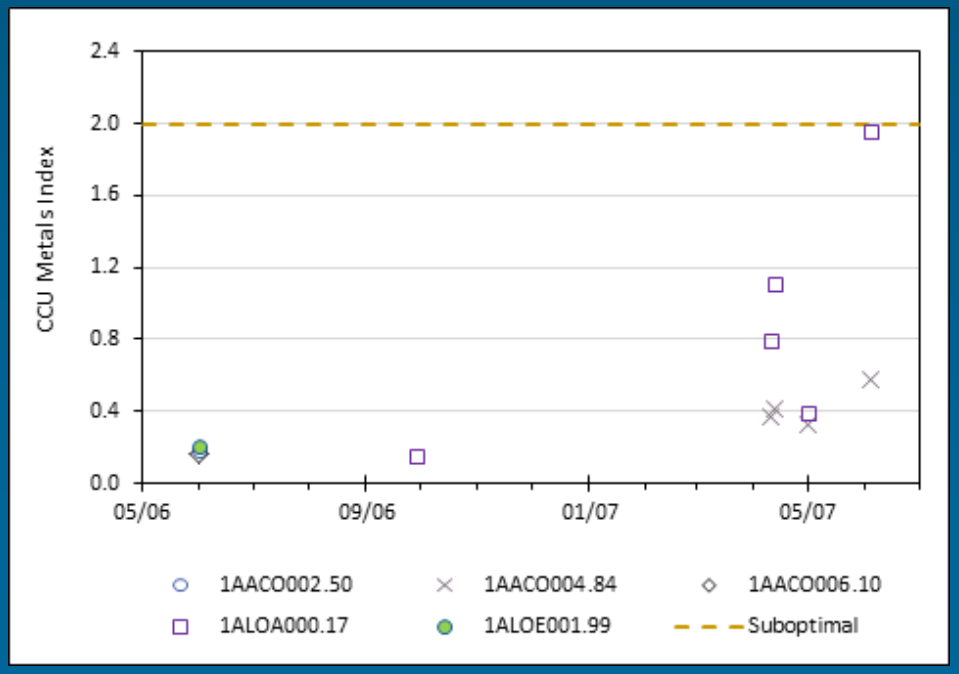
USGS National Water Quality Assessment Program Site

DEQ Metals and Toxics Monitoring, 2000-2014

Medium	Metals
Water Column	12 (dissolved)
Sediment	3
Fish Tissue	11

Metals

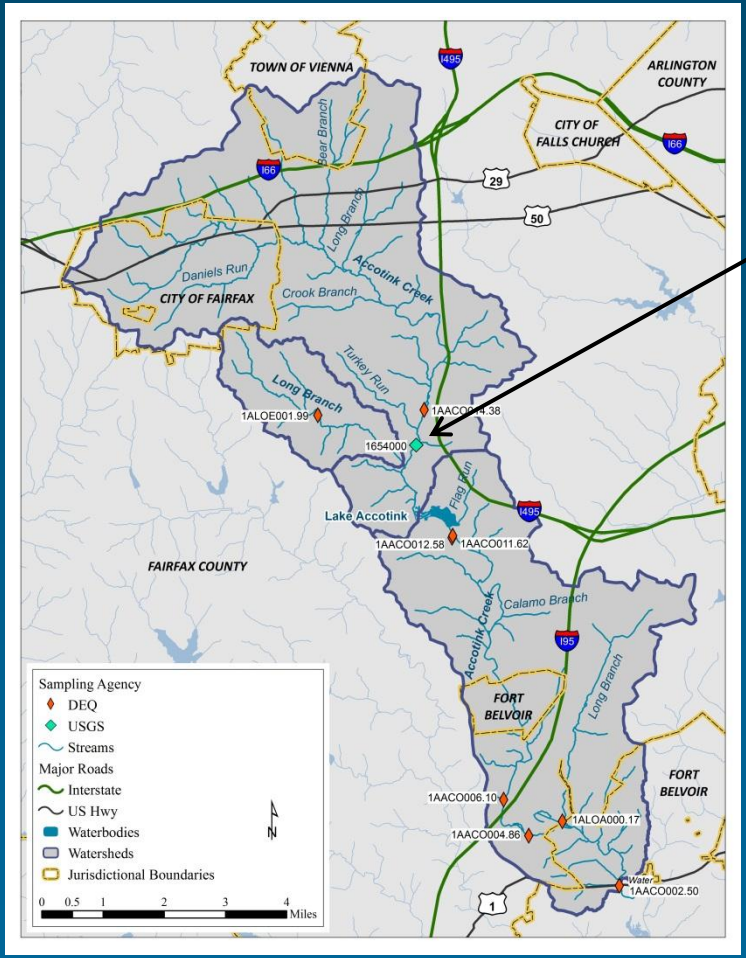
- Water column Water Quality Standards for metals are met
- Cumulative Criterion Index (CCU) for metal samples are below ProbMon suboptimal threshold
- All metal sediment concentrations are below TECs
- Only one of eleven arsenic concentrations in fish tissue above TV; all other fish tissue metal concentrations are below TVs or TSVs



Possible Stressors

- Toxics
- Nutrients

Toxics Monitoring



USGS National Water Quality Assessment Program Site

DEQ Toxics Monitoring, 2000-2014

Medium	Toxics
Water Column	4
Sediment	2
Fish Tissue	7-16

Toxics

Medium	Key Observations
Toxicity Tests	• No evidence of toxics effects in two samples tested on water fleas • One of two samples tested on minnows had biologically significant effects
Water Column	No exceedences of Water Quality Standards
Sediment	Some PAHs and chlordane detected above TEC but below PEC
Fish Tissue	• Lower Accotink Creek not supporting Fish Consumption Use (human health criterion) because of PCBs • Chlordane measured in fish tissue above TV in 1 of 13 samples • Heptachlor epoxide measured in fish tissue above TV in 2 of 7 samples • Dieldrin measured in fish tissue above TV in 1 of 1 sample

Nutrients

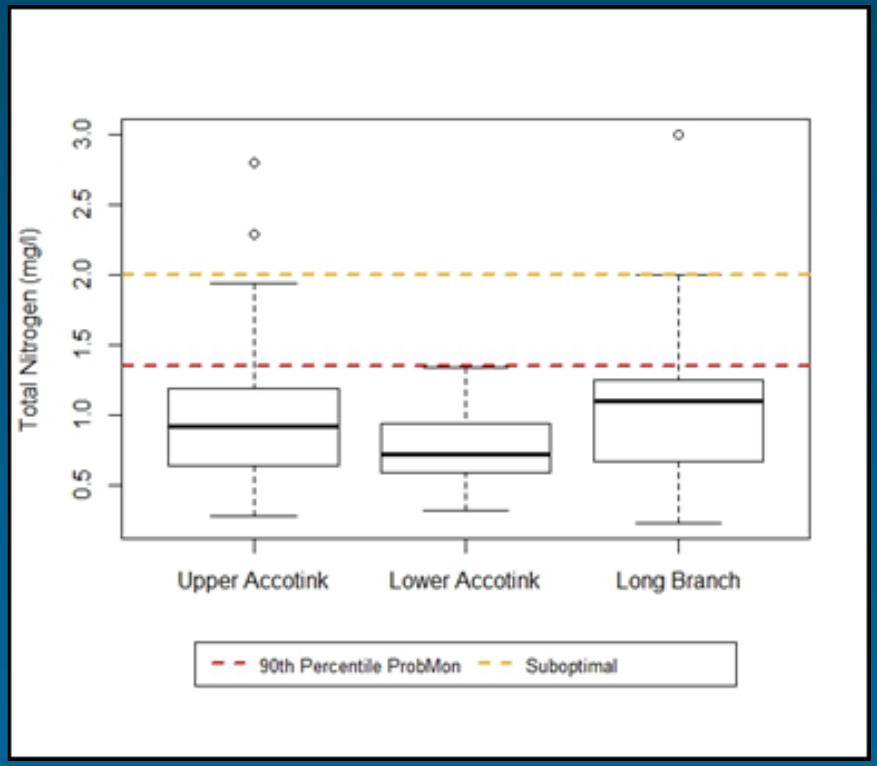
Are nutrient concentrations high relative to ProbMon thresholds?	?
Is there any evidence for excess primary production in the continuous monitoring data?	?

Nutrients

Watershed	TN Observations	TP Observations
Upper Accotink	236	287
Lower Accotink	44	64
Long Branch	75	76

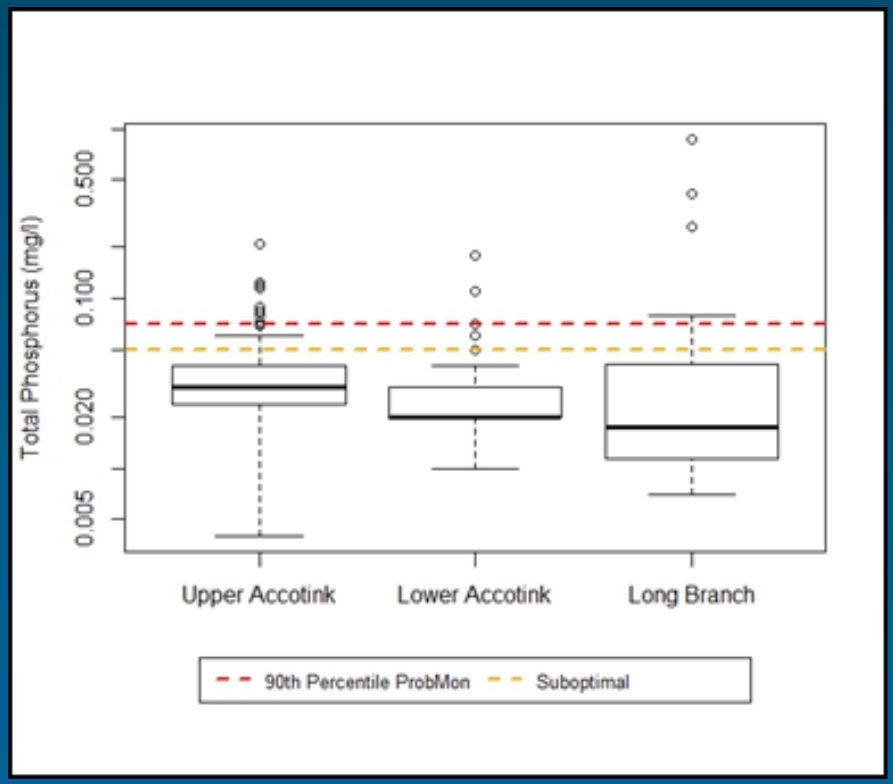
Observed TN Concentrations

Watershed	> Suboptimal Threshold	> 90th Percentile ProbMon
Upper Accotink	1%	13%
Lower Accotink	0%	0%
Long Branch	5%	20%



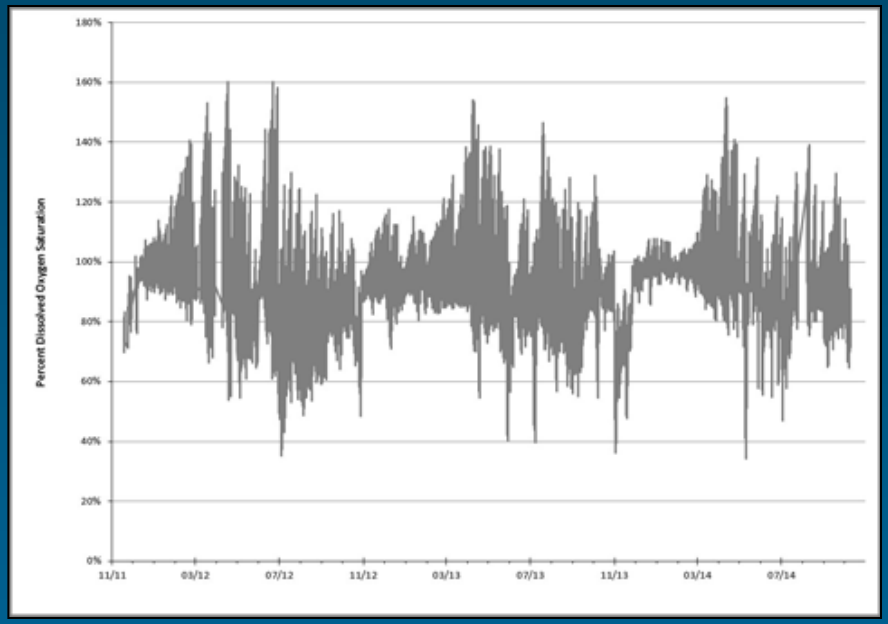
Observed TP Concentrations

Watershed	> Suboptimal Threshold	> 90th Percentile ProbMon
Upper Accotink	13%	5%
Lower Accotink	8%	4%
Long Branch	19%	19%



Dissolved Oxygen Fluctuations

- Supersaturated DO concentrations observed in Accotink Creek, and
- Wide daily fluctuations in DO concentrations, but
- DO Water Quality Standards are met

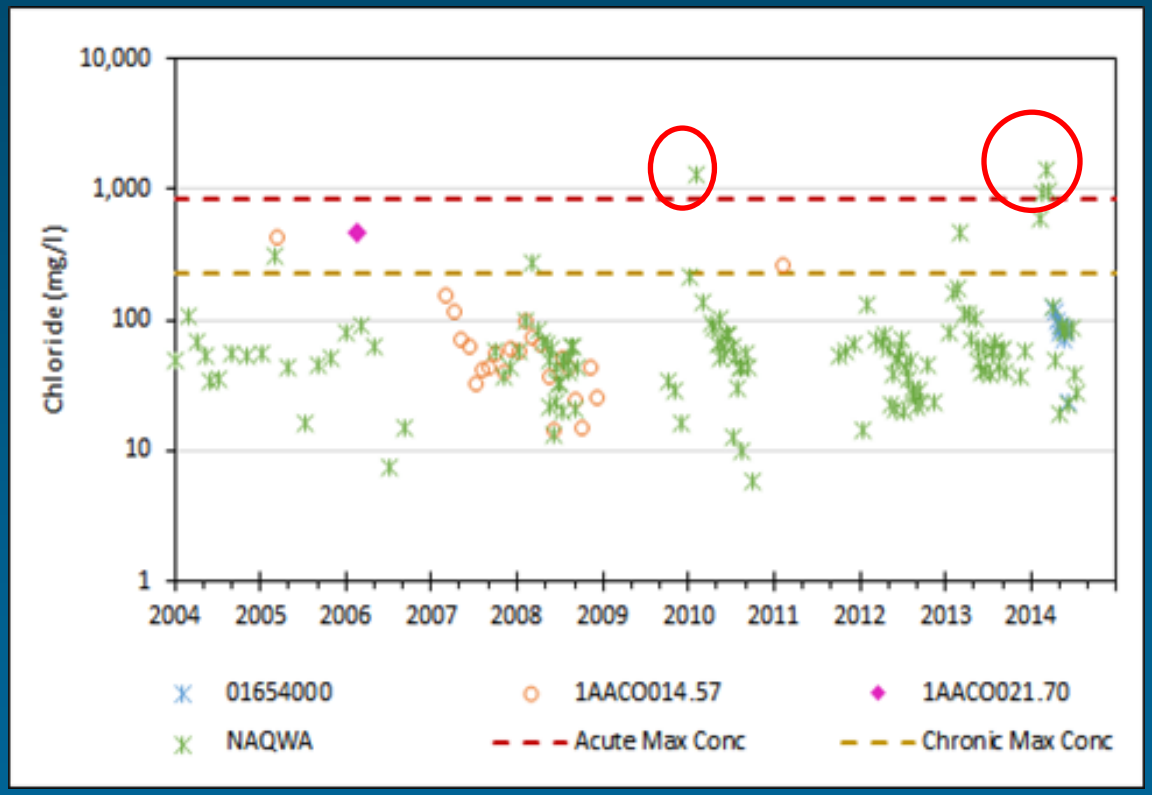


Percent DO Saturation
Accotink Creek near Ranger Road

Most Probable Stressors

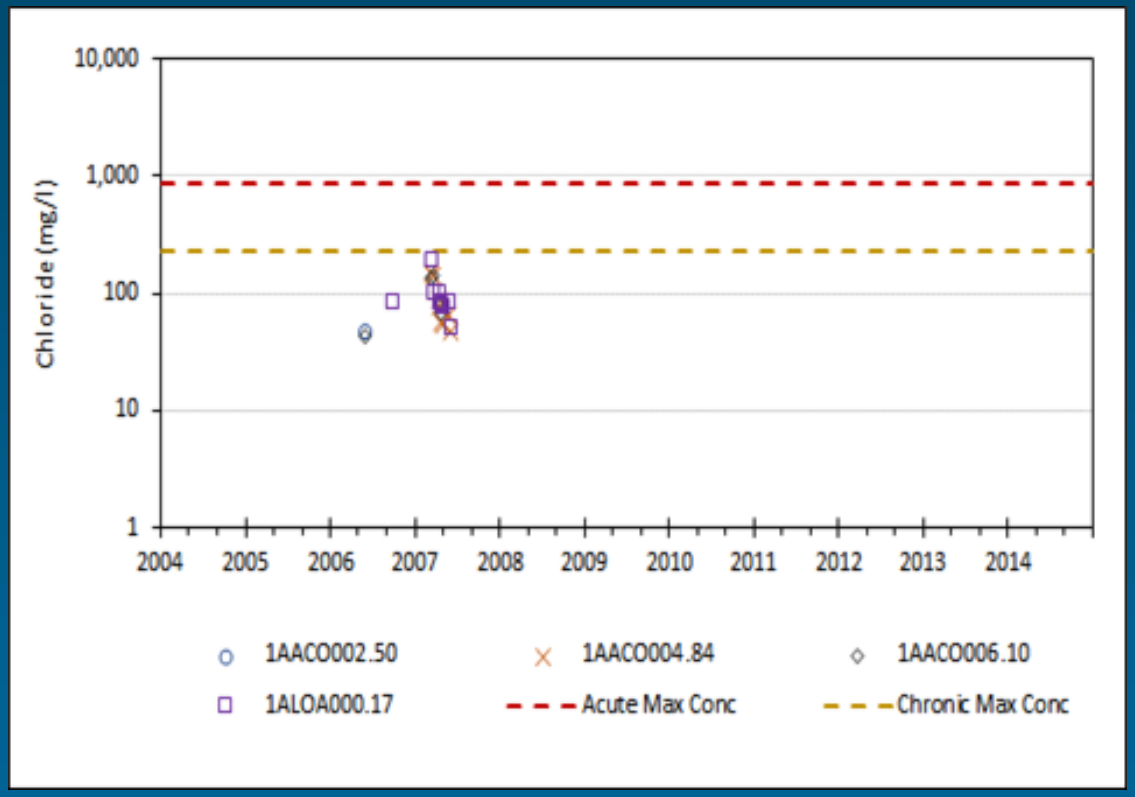
- Chlorides
- Habitat Modification
- Sediment
- Hydromodification

Observed Chloride Concentrations, Upper Accotink Creek



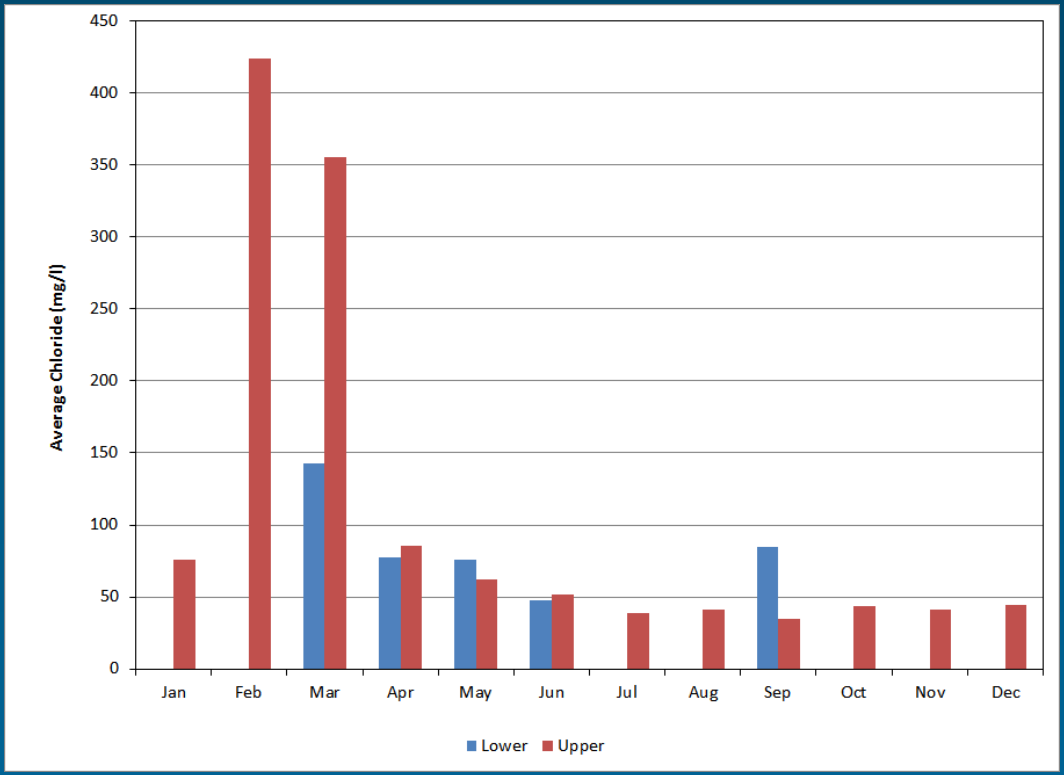
25 samples collected by DEQ and 146 samples collected by USGS, 2004-2014

Observed Chloride Concentrations, Lower Accotink Creek



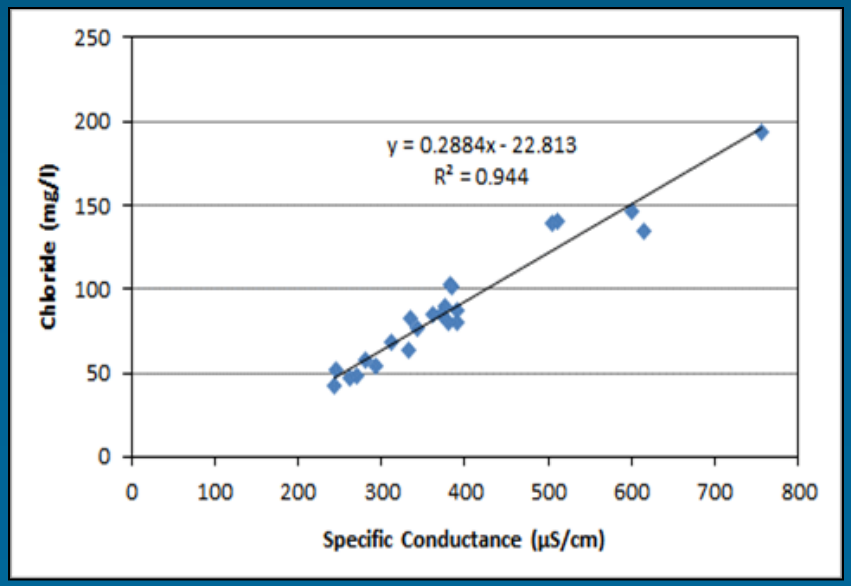
23 samples collected by DEQ 2004-2014. (No samples collected by USGS.)

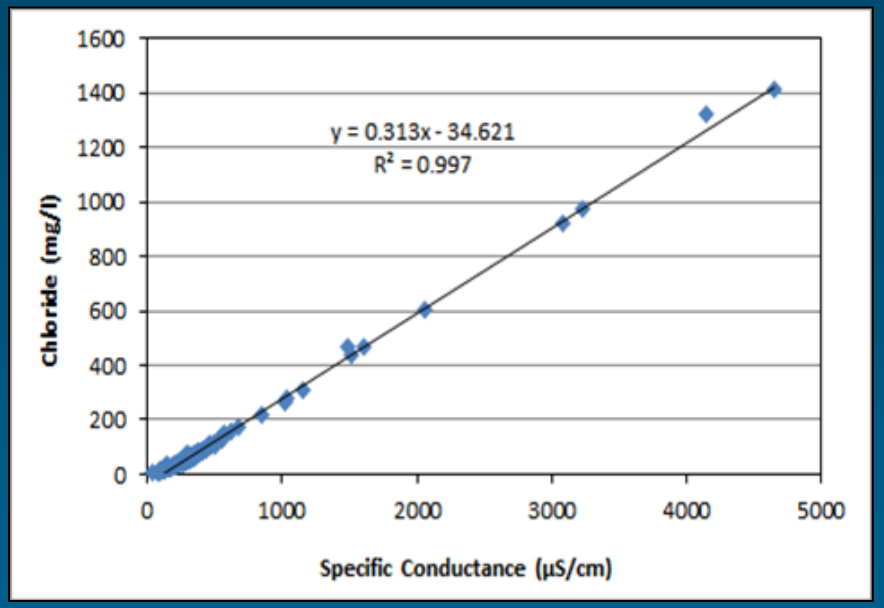
Seasonality of Chloride Concentrations



Correlation Between Chloride and Specific Conductance

Lower Accotink Creek:
Cl = 0.29* SC-22.8

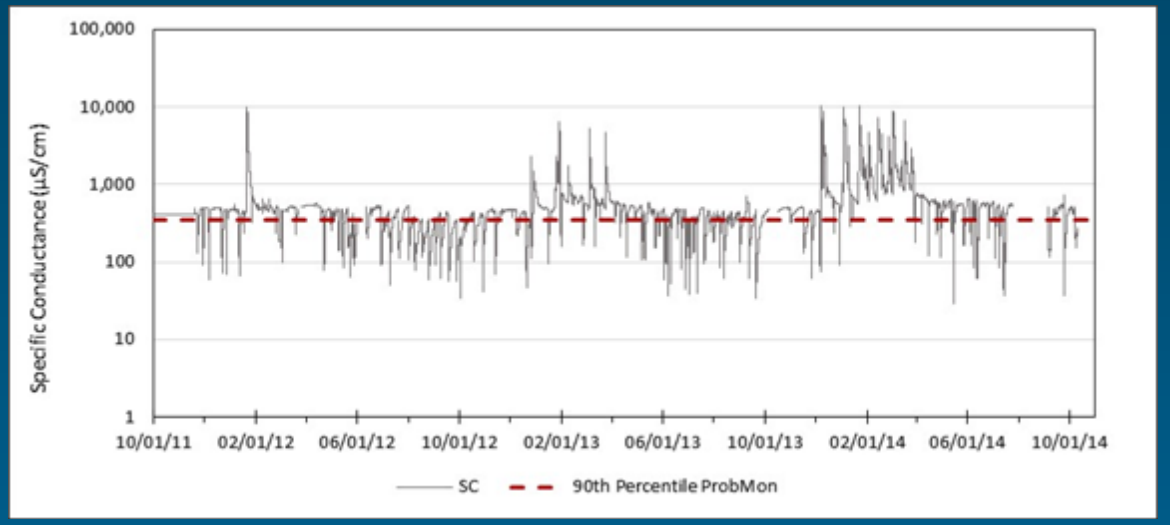




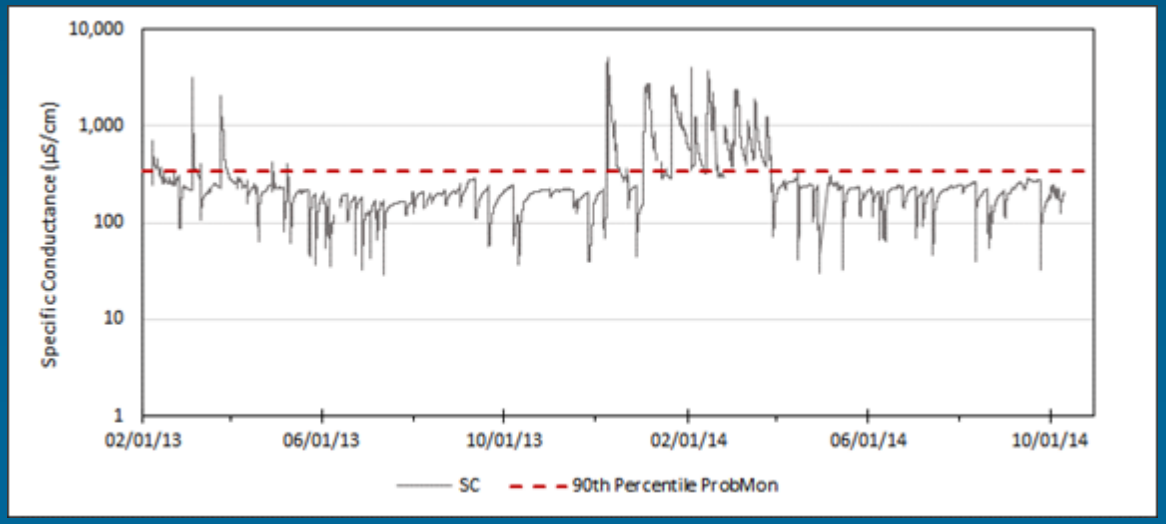
Upper Accotink Creek:
Cl = 0.31*SC -34.6

Specific Conductance Continuous Monitoring Data

Upper Accotink Creek

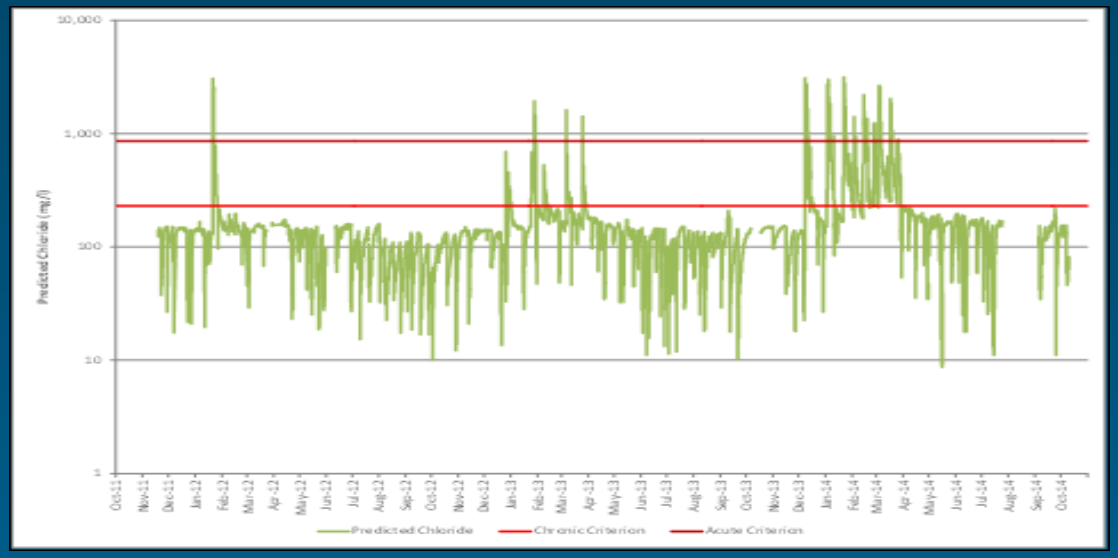


Long Branch

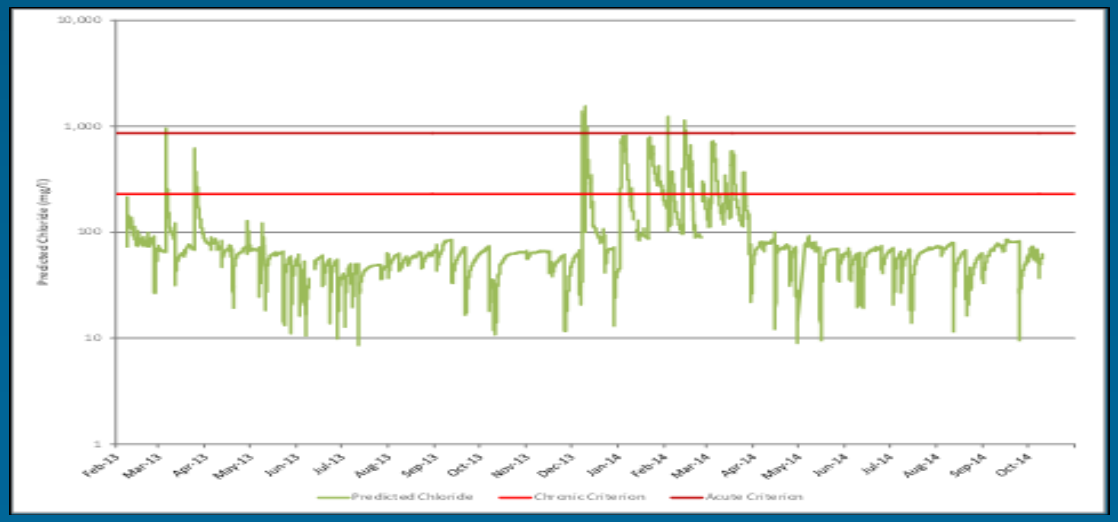


Predicted Chloride Concentrations
Assume Cl = 0.3 * SC

Upper Accotink Creek:
32 days > acute criterion
12% exceedance of chronic criterion



Long Branch:
4 days > acute criterion
8% exceedance of chronic criterion

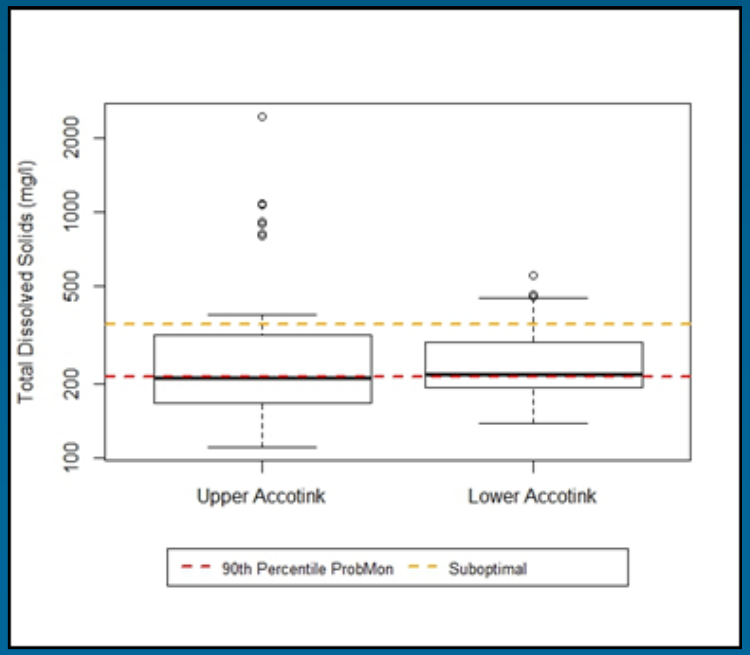


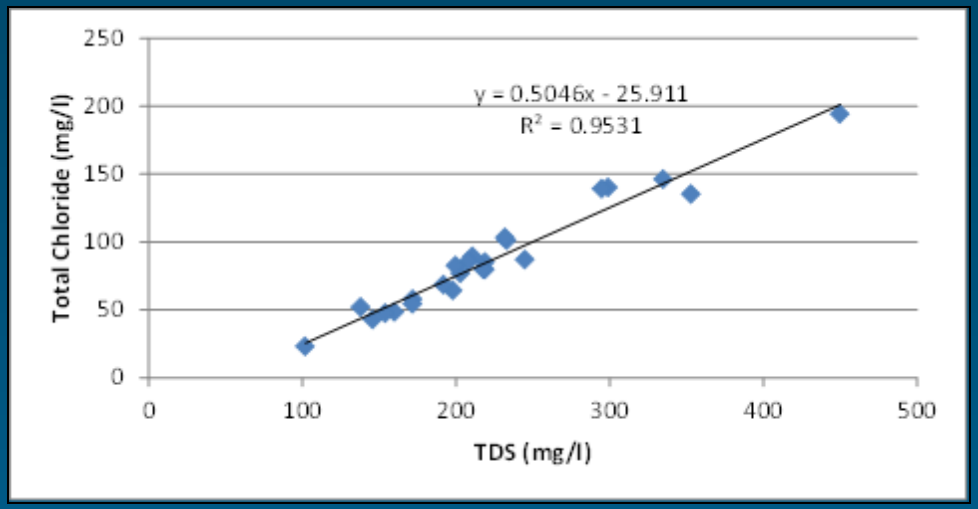
Lower Accotink Creek

- Don’t have winter continuous monitoring data for specific conductance, but
- Land use and percent impervious area in lower Accotink Creek similar to upper Accotink Creek
- Distribution of concentrations of Total Dissolved Solids (TDS) are similar, and TDS is correlated with chloride

TDS and Chloride, Lower Accotink Creek

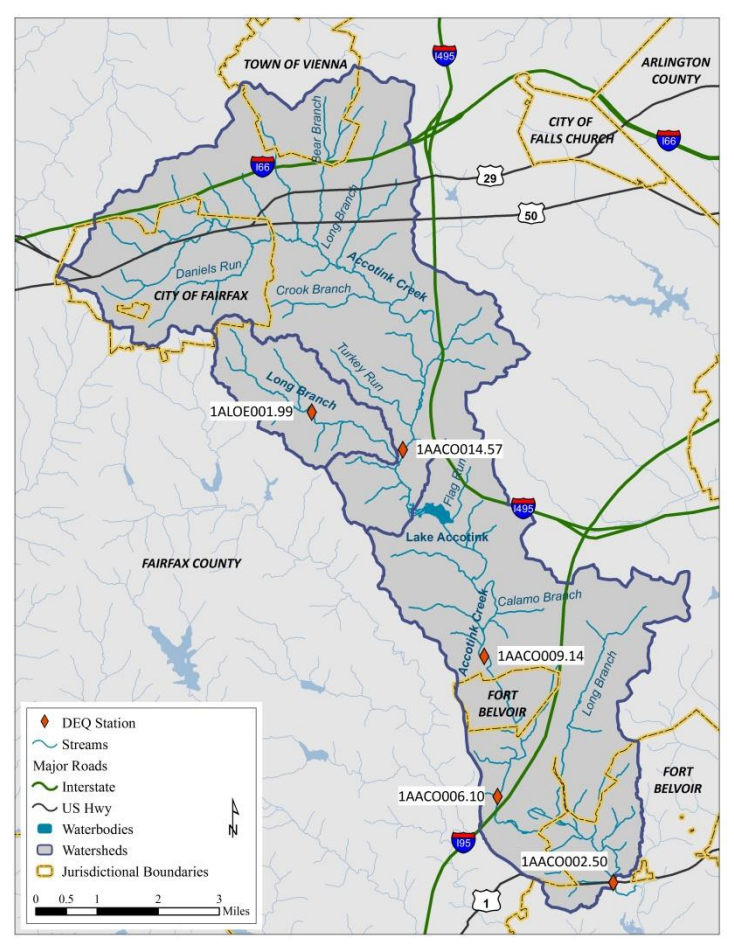
Distribution of TDS concentrations under ambient (baseflow) conditions

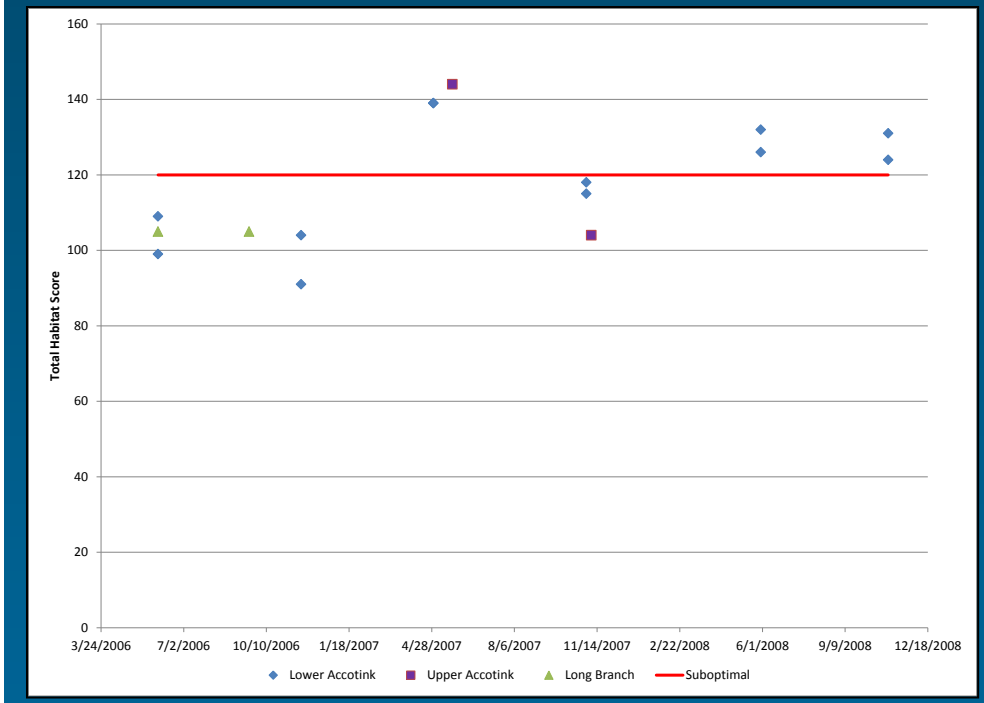




Lower Accotink Creek:
Cl = 0.50*TDS -25.9

DEQ Habitat Assessments 2006-2008





Fairfax County Stream Physical Assessment (SPA) Habitat Assessment

Rating	Percent Assessed
Very Poor	3.7%
Poor	30.5%
Fair	37.2%
Good	24.0%
Excellent	4.5%

Marginal or Poor Habitat Metrics

DEQ

- Bank Stability
- Bank Vegetation
- Embeddedness
- Sediment deposition
- Epifaunal Substrate

SPA

- Bank Stability
- Bank Vegetation
- Embeddedness
- Channel Flow
- Almost all metrics marginal in upper Accotink Creek watershed
- Over 50% of the tributaries to upper Accotink Creek have inadequate riparian buffers

Sediment: Impacts

Suspended Sediment

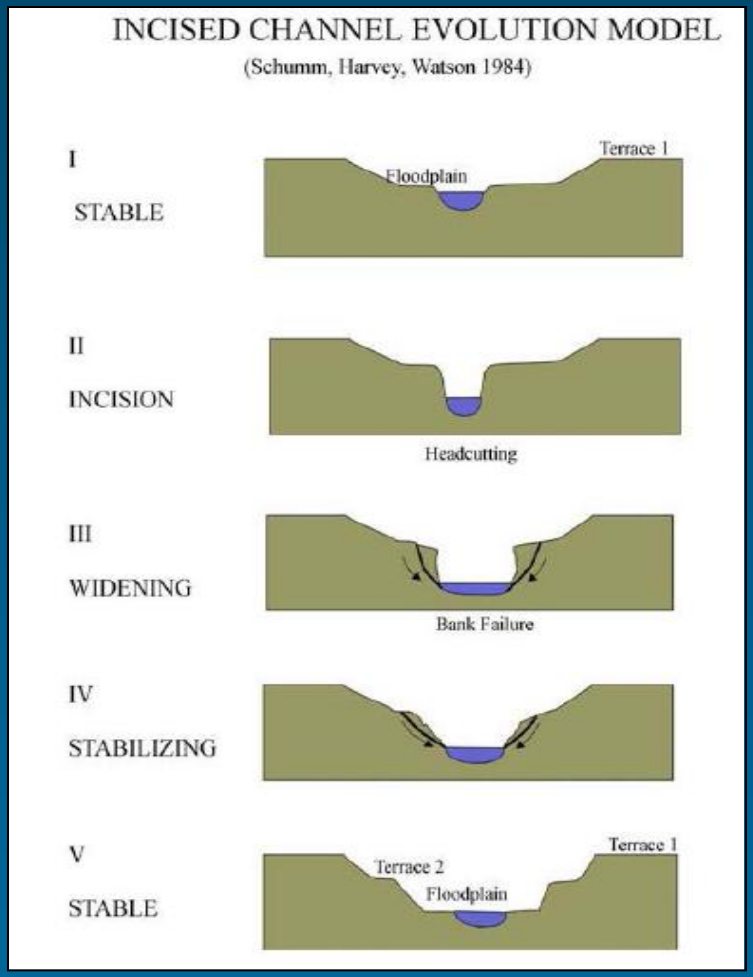
- Limits light for photosynthesis
- Reduce quality of food for filter feeders
- Reduced visibility for predators
- Increases drift and inhibits recolonization
- Damages stalks of plants, fish gills, and bodily parts of macroinvertebrates

Deposited Sediment

- Bury periphyton, macroinvertebrates, and fish eggs or larvae.
- Cover hard substrate favored by sensitive macroinvertebrates
- Fill in spaces between substrate used for refuge
- Reduce supply of gravel and clean substrate used for spawning by trout and other species

Fairfax County SPA Channel Evolution Model (CH2MHill, 2005)

- 77% of watershed stream miles assessed using Channel Evolution Model
- 90% of assessed reaches (by feet) classified as Type III, actively widening channels



Other Evidence for Sediment Impacts

- DEQ and SPA Habitat Assessments: Marginal or Poor scores for Bank Stability, Bank Vegetation, Embeddedness, Sediment Deposition
- SPA: Percent of stream length with sand or finer material as dominant substrate >30% in mainstem
- SPA: 23% of reaches surveyed had active bank erosion sites 2 ft or greater in height (only 1% of total stream length)
- FCDPWES: Dominant taxa are Oligochaeta and Chironomidae, many of whose preferred habitat is sand, silt, mud, or detritus.

Hydromodification

- 87% of the Accotink Creek watershed is in commercial, industrial, residential, or transportation land uses
  - 29% impervious cover
- Definition of Hydromodification:
  - Flow alteration
  - Channelization
  - Replacement of small-order streams by storm sewer drainage system

Hydromodification: Impacts

- Increase in magnitude and frequency of flow during storm events: greater scouring of periphyton and dislodging of benthic fauna
- Disconnection of streams from groundwater: (1) increases in temperature and (2) less biological processing of nutrients in hyporheic zone
- Straightening channels: loss of habitat diversity
- Loss of headwater streams: (1) less biological processing of organic carbon; (2) loss of upstream colonists

Accotink Creek is suffering from the "Urban Stream Syndrome"

- Flashier flows
- Elevated nutrient and/or contaminant concentrations
- Fewer smaller streams and lower stream density
- Altered channel morphology
- Reduction in biological diversity with increases in pollution-tolerant taxa

Stressor Analysis Conclusions

- Address the benthic impairments by developing TMDLs for pollutant stressors
  - Sediment
  - Chloride

- Non-pollutant stressors may be addressed through implementation practices
  - Hydromodification
  - Habitat Modification

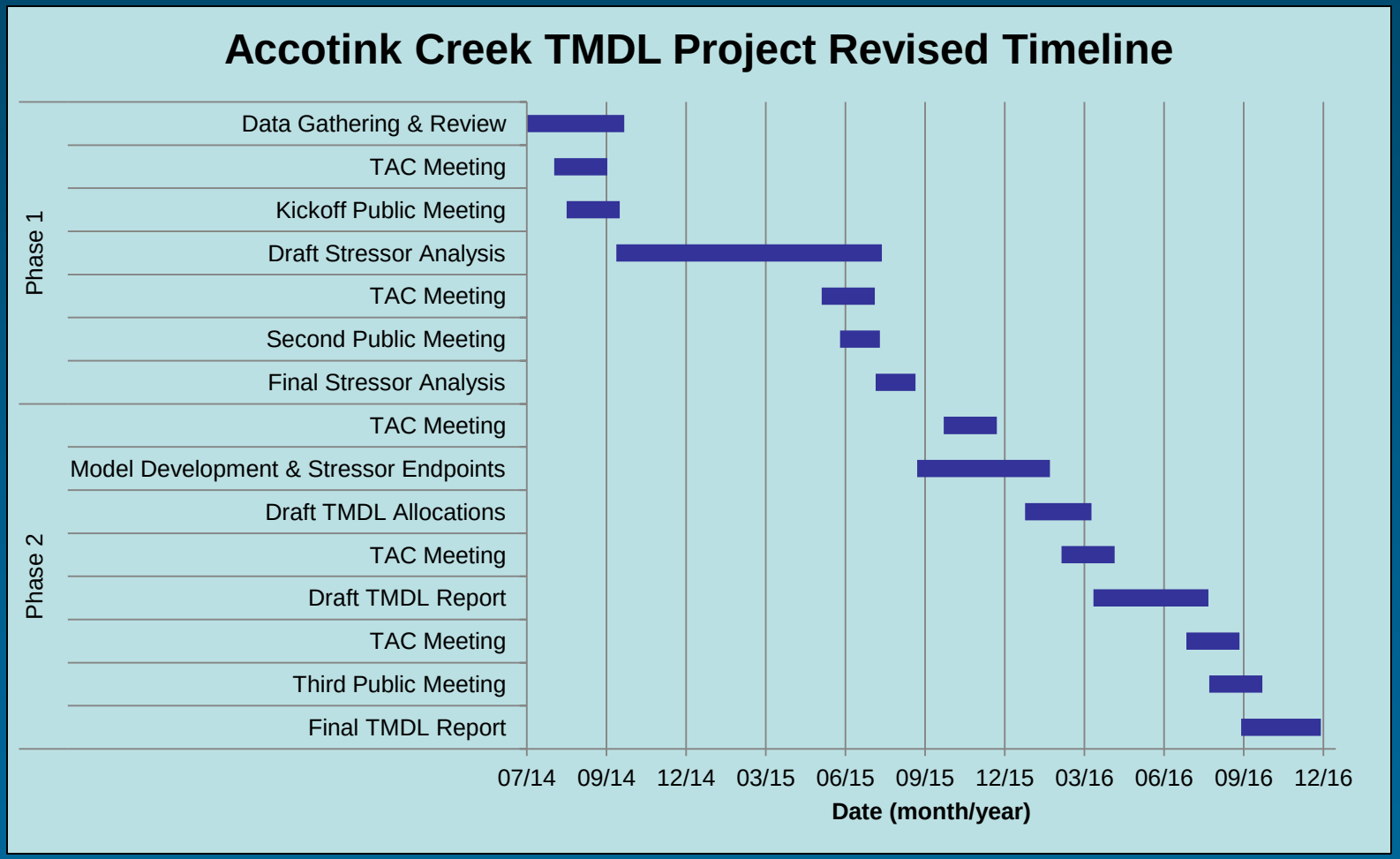
Next Steps

- Present stressor analysis information to the public

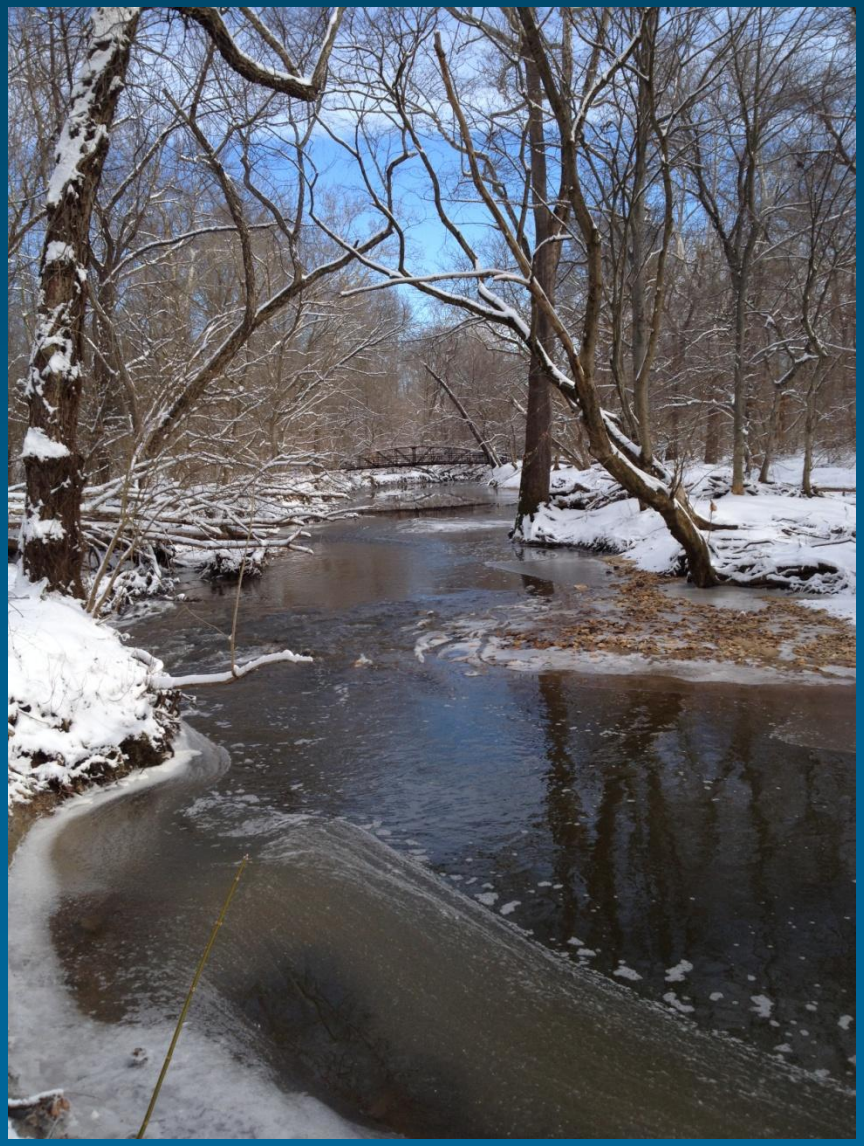
  Second Public Meeting
  Monday, July 6, 2015 6:30 pm
  Kings Park Library - Meeting Room
  9000 Burke Lake Road, Burke, VA 22015-1683
  703-978-5600

  Comment period ends August 5, 2015

Proposed Project Timeline



Questions? Comments?



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